DOCUMENT RESUME

ED 309 397 CS 009 747

AUTHOR Meyers, Joel; And Others
TITLE Think-Aloud Protocol Analysis of Reading Comprehension Tactics Used by Students with Reading Problems.
SPONS AGENCY Special Education Programs (ED/OSERS), Washington, DC.
PUB DATE Mar 89
GRANT G008730250
NOTE 23p.; Paper presented at the Annual Meeting of the American Educational Research Association (San Francisco, CA, March 27-31, 1989). For related studies, see CS 009 745-746.
PUB TYPE Speeches/Conference Papers (150) -- Reports - Research/Technical (143)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Elementary Education; *Evaluation Methods; Grade 2; Grade 3; Grade 4; Grade 5; Protocol Analysis; *Reading Comprehension; Reading Difficulties; Reading Research; *Reading Strategies; *Remedial Reading
IDENTIFIERS *Think Aloud Protocol

ABSTRACT

A study investigated whether a student's repertoire of comprehension-fostering tactics could be reliably identified, with the expectation that this sort of diagnostic profile might serve as a basis for an individualized remedial program. Subjects, 81 second, third, fourth, and fifth grade students enrolled in remedial reading programs in six different upstate New York schools, had their think-aloud protocols gathered as they read two short passages. Subjects' responses were analyzed using a system of six categories of comprehension tactics. Results paralleled prior research with "non-problem" readers and indicated that signaling understanding, elaboration, and reasoning are used most frequently, that monitoring is used less frequently, and that analysis and judging are used rarely. Results also indicated no correlation between the use of these comprehension tactics and a standardized measure of reading comprehension. (Four tables of data are included, and 24 references are attached.) (RS)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED309397

Think-Aloud Protocol Analysis of Reading Comprehension Tactics Used by Students with Reading Problems

Joel Meyers, Lynn Gelzheiser and Robert Pruzek
Department of Educational Psychology and Statistics
State University of New York at Albany

Author Notes: The research reported here was supported by a grant (contract number G008730250) from the U.S. Office of Special Education Programs. The authors wish to thank Christine Modafferi and Susan Siewic who collected the data. Thanks are also due to Pryadarshi Datta for assisting with the data analysis.

Requests for reprints should be sent to Joel Meyers, ED 232, State University of New York, 1400 Washington Avenue, Albany, NY 12222.

Paper presented at the Annual Meetings of the American Educational Research Association, 1989, San Francisco.

Running Head: Protocol Analysis

CS005747

BEST COPY AVAILABLE

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Joel Meyers
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
☐ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy

Abstract

This investigation used Lytle's (1985) approach to coding think-aloud protocols to determine whether a student's repertoire of comprehension-fostering tactics could be reliably identified. A sample of elementary school students experiencing difficulty with reading was used to determine: (1) the degree to which this sample use the various moves described by this system; (2) the stability of these data across two passages; (3) the relationship between moves and standardized achievement measures; (4) the relationship between moves and comprehension of the story used to gather the think-aloud protocols; and (5) the degree to which this sample used sequences of moves. The results parallel prior research with "non-problem" elementary school readers indicating that 3 moves (signaling understanding, elaboration, and reasoning) are used most frequently, that monitoring is used less frequently, and that two moves (analysis and judging) are used rarely. Further support for the stability of these findings is suggested by strong correlations between the moves used in the two stories read by reach subject. While there were no relationships between these moves and a standardized measure of reading comprehension, there were moderate relationships to a non-standardized measure of comprehension for the total Number of Moves, Elaboration , and Reasoning. In addition, this sample did not make much use of move sequences and there were low to moderate correlations between move sequences and passage comprehension.

Think-Aloud Protocol Analysis of Reading Comprehension Tactics Used by Students with Reading Problems

Reading comprehension is an interactive process in which the reader constructs meaning based on prior knowledge, characteristics of the text, and the reader's use of comprehension strategies (Orasanu & Penney, 1986; Rumelhart, 1980). Readers who fail to employ appropriate comprehension-fostering strategies may suffer comprehension loss (Baker & Brown, 1984; Brown, 1980). The comprehension of poor readers has been improved by instruction designed to increase use of comprehension strategies (Brown, Armbruster & Baker, 1986).

Although there is ample documentation of the importance of reading comprehension strategies, steps remain to be taken in translating our understanding into practice. This investigation explored whether a student's repertoire of comprehension-fostering tactics could be reliably identified, with the expectation that this sort of diagnostic profile might serve as the basis for an individualized remedial program. For example, an hypothesis emerging from clinical work with elementary school students is that unsuccessful readers often rely on one particular type of move (e.g, signaling understanding or elaboration), make responses that are irrelevant to the comprehension task, and/or fail to use monitoring moves. Also, many unsuccessful readers may fail to use strategic sequences of problem solving behavior after monitoring their failure to understand (Meyers & Kundert, 1988; Meyers & Lytle, 1986; Meyers, 1988). This investigation assessed the comprehension strategies of remedial reading and resource room students, as students in these special programs are appropriate targets for individualized remediation, and it explored the validity of one approach to assessment of students' comprehension

tactics, by examining the relationship between tactics used (i.e., moves and strategies) and comprehension.

Think-aloud protocol analysis was selected as the assessment approach, as it provides an "online" measure of cognitive activity during reading (e.g., Bereiter & Bird, 1985; Lytle, 1985; Olshavsky, 1976/77; Scardamalia & Bereiter, 1984). Of course, there has been considerable debate about the validity of data derived from verbal reports such as think-aloud protocols (e.g., Afflerbach & Johnston, 1984; Ericsson & Simon, 1980; Nisbett & Wilson, 1977). Moreover, the methods used to gather think-aloud protocols require modifications in reading (i.e., reading one sentence at a time, thinking out loud after each sentence) that slow down and may even alter the reading process for some readers (Lytle, 1985). Nevertheless, it has been argued that this is an effective methodology to provide information concerning the specific tactics used by readers during reading (Lytle, 1985). It is assumed that these protocols reflect, but do not reproduce the reader's cognitive processing and comprehension tactics.

Lytle's (1985) approach to think-aloud protocol analysis was selected for this investigation because it assesses the reader's ongoing thoughts after each sentence, it uses a flexible coding system that reflects the thinking process rather than requiring one score for every clause, and it relies on a set of instructions and queries that influences the subject's responses minimally (Lytle, 1985; Meyers & Lytle, 1986). "Moves" are responses reflecting what the reader is doing at a particular point in time to understand what he/she is reading, and "strategies" are the patterns of moves utilized to solve a particular problem with comprehension. While much of the research on reading comprehension is focused on strategies, the simultaneous emphasis on moves will facilitate efforts to develop a

picture of the entire ongoing thinking process that occurs during reading.

Six categories of comprehension tactics (i.e., moves) are assessed, and these have been documented as important components of reading comprehension. Each of these categories and the specific moves contained within each category are reproduced in Table 1, and they are defined elsewhere in more detail[1] (Lytle, 1982; 1985; Meyers, 1988).
(1) Signaling Understanding (e.g., paraphrasing) occurs through the reader's ongoing efforts to summarize what is being read. This may be used by the reader to check his or her understanding of the passage (Bereiter & Bird, 1985; Scardamalia & Bereiter, 1984), (2) Monitoring Doubts is used when the reader does not understand (or only partially understands) the reading material. The reader must first recognize the failure to understand prior to taking any remedial steps needed to facilitate comprehension (Brown, 1980), (3) Elaborating on the Text is viewed as a particularly important tactic by those who view reading as an interaction between the contents of the text and prior knowledge of the individual reader. Elaboration is used when the reader adds details to the text as a part of an effort to construct meaning. (Ballstaedt & Mandl, 1984; Kintsch & vanDijk, 1978; Rumelhart, 1980). (4) Reasoning has frequently been documented as a comprehension tactic. It is an important component of the monitoring process in which the reader asks questions, formulates hypotheses and makes predictions in an effort to facilitate understanding and to plan the sequence of moves needed to overcome comprehension difficulties (Brown, 1978; 1980). (5) Analyzing text Features and (6) Judging the Text have been described as behaviors used by sophisticated readers (Lytle, 1982; 1985). These categories of moves may be most likely when the nature of the text or the purpose of reading lend themselves to an assessment of the text and the author's purposes.

---

insert Table 1 about here

Although the importance of each move assessed has been documented in the literature, there is only limited evidence that strategies revealed by this procedure influence comprehension. Meyers, Palladino & Devenpeck (1987) found that that most moves did not relate to standardized measures of achievement using an average sample of readers. One Signaling Understanding move correlated with a standardized measure of reading comprehension, and one Elaboration move correlated with intelligence.

The purpose of this investigation was to extend the findings of this earlier research using a sample of elementary school children experiencing mild reading problems. The particular questions addressed by this research included the following: (1) To what degree does this sample of readers use the various moves described by this system? (2) To what degree are these data stable as reflected by concordance between the moves used across two different stories? (3) What is the relationship between moves and standardized measures of reading and achievement? (4) What is the relationship between moves and comprehension of the story used to gather the think-aloud protocol? (5) To what extent does this sample use sequences of moves, and to what degree do these sequences of moves relate to reading comprehension?

Methods

Subjects

There were 81 subjects (17 male & 6 female second graders, 11 male and 8 female third graders, 19 male and 4 female fourth graders, 8 male

and 8 female fifth graders), from 6 different school districts in upstate New York (2 urban, 2 rural, & 2 suburban). All were experiencing reading problems at the time of the study and were enrolled in either remedial reading (48 students) or resource room (33 students) programs.

Instruments

Standardized measures of achievement included the reading comprehension, vocabulary and language subtests from the Stanford Achievement Test (Gardner, Rudman, Karlsen, & Merwin, 1982), and the Decoding Skills Test (Richardson & DiBeneddetto, 1985). This sample scored at the 3.4 grade level (SD = 1.2) on the contextual decoding section of the Decoding Skills Test. Percentile scores for this sample on the sub-tests from the Stanford Achievement Tests were 22.6 (SD = 20.9) for reading comprehension, 41.0 (SD = 25.1) for Vocabulary, and 38.0 (SD = 25.3) for Language.

Think-aloud protocols were obtained by asking subjects to read two passages ranging from 13 to 16 sentences in length. A total of six passages were divided into three sets of two passages each based on difficulty level as determined from pilot work using these passages with elementary school children enrolled in remedial reading[2]. To minimize the confounding effects of differences in decoding ability, the most difficult pair of passages was selected for those students who obtained contextual decoding scores of at least 4.3 on the Decoding Skills Test; the moderately difficult pair of passages was selected for those students scoring from the 3.3 to the 4.3 grade levels on the Decoding Skills Test; and the easiest pair of passages was selected for those students scoring at or below the 2.8 grade level on the Decoding Skills Test.

Procedures

Examiners. Data were collected by one of four examiners, a graduate student in Reading, two graduate student in School Psychology, and one faculty member in Educational Psychology with prior experience as a school psychologist. All examiners had prior experience testing children as well as specific experience with think-aloud protocol analysis.

Collecting Think-Aloud Protocols. The passage was placed in front of the student with all sentences covered by a piece of paper. Each sentence was uncovered one at a time and read by the student. The student was instructed to tell the examiner everything that (s)he was doing or thinking about while attempting to understand the story after reading each sentence. The think-aloud task was explained using instructions that are described elsewhere (i.e., Lytle, 1985; Meyers, 1988), and examiners were trained to use as few probing questions as possible to minimize the examiner's influence. Consistent with previous methodology, all reponses and questions by both the examiner and student were written verbatim by the examiner, rather than using tape recordings to gather these data. This approach was based on research suggesting that both approaches result in comparable data (Meyers, Lytle, Palladino, Devenpeck, & Green, unpublished manuscript) as well as the notion that verbatim recording may be more practical for an assessment technique that might be used by practitioners (i.e., Meyers, 1988; Meyers & Lytle, 1986). After the passage was completed, the students summarized what they had recalled to assess comprehension of the passage read while gathering the think-aloud protocol. Each subject was then asked to repeat this procedure with a second passage. The entire process for gathering think-aloud protocols from the two passages was completed in one 40-minute session.

Coding and Reliability. The verbatim protocols of the subjects'

think-aloud responses to the two passages provided the basis for later coding and data analysis, and responses were scored using an adaptation of Lytle's (1985) scoring system[1]. After training provided during previous research, the two coders demonstrated consistent inter-rater agreement of 80% or more. Reliability was determined based on the two raters' agreement about which of the 24 specific moves occurred in the subject's response to each sentence in the story. Reliability was assessed initially on the two protocols obtained for the first 11 of the 81 subjects. During this phase of reliability about four protocols were scored prior to weekly meetings between the two coders. These meetings were used to check reliability and to discuss any confusions regarding the coding system. When disagreements occurred in which it was agreed that one of the coders had made an obvious error in application of the coding rules, the score was changed accordingly; when there was not a clear resolution to such disagreements the original coder's score was used. Reliability for this phase averaged 86% inter-rater agreement, with a range of 78 - 96%. Spot checks were conducted on five additional subjects during coding of the remaining 70 subjects, and the results indicated that satisfactory levels of reliability were maintained (inter-rater agreement across these five subjects = 83%).

Student comprehension of the think-aloud passages was assessed by calculating the frequency of content words from the passage contained in each reader's summary (Fuchs, Fuchs, & Maxwell, 1988).

Results

Question 1: Normative Data. The data were analyzed initially by assessing the frequency of moves per sentence used by all 81 of the subjects in this study for each of the two stories, and these results are

reported in Table 2. The three most frequently used catergories of moves were Signaling Understanding, Elaboration and Reasoning. Monitoring was used less frequently, and both Analysis and Judging were rarely used. (Report some of the data for specific moves in addition to the move categories.)

---

insert Table 2 about here

Question 2: Stability of Data. Table 2 suggests that the mean frequency of moves per sentence used by this sample was essentially equal in the two stories that were administered. The stability of individudal students' profiles was confirmed by a correlational analysis indicating strong relationships between the two stories for each major category of moves and for the total number of moves used in each story (Total Number of Moves, $r = .79$, $p < .001$; Monitoring r, $= .49$, $p < .001$; Signaling Understanding, $r = .68$, $p < .001$; Elaboration, $r = .62$, $p < .001$; Reasoning, $r = .83$, $p < .001$; Analysis, $r = .35$, $p < .01$; Judging, $r = .83$, $p < .001$).

Question 3: Relation of Moves with Standardized Measures of Achievement. Correlations were computed to determine the relationships between moves and achievement as measured by the Decoding Skills Test, and the reading comprehension, vocabulary and language subtests of the Stanford Achievement Tests. These correlations are reported in Table 3. Since a large number of correlations was computed, .01 was set as the signficance level. There were significant correlations between the Decoding Skills Test and two of the six categories of moves. Monitoring correlated positively with the Decoding Skills Test, and Signaling Understanding correlated postively with the Decoding Skills Test on story

1 only. There were no significant correlations with any of the Stanford Achievement Test subscales (i.e., Comprehension, Vocabulary, or Language).

---

insert Table 3 about here

Question 4: The Relation of Moves to Passage Comprehension. Table 4 indicates that there were significant relationships between student comprehension of each passage (measured by the number of content words included in the student summaries), and the moves used by each student. The most consistent significant relationships were found for Total Number of Moves, the frequency of Elaboration Moves, and the frequency of Reasoning Moves. Table 4 indicates that the most consistent significant correlations between passage comprehension and the specific moves described in Table 1 were found for two Elaboration Moves (E3 and E4), and one Reasoning Move (R4).

---

insert Table 4 about here

Question 5: Sequences of Moves. It has been suggested that strategic comprehension behavior is assessed best by examining the sequences of moves that occur after a reader acknowledges doubt (Lytle, 1985). This was examined in the present study by considering three moves from the coding system that generally involve doubt on the part of the reader (i.e., monitoring doubts, M1; hypothesis, R1; and questioning, R3), and determining whether these moves were followed by at least one other move. In those instances when no other move was revealed it was assumed that the reader was not using strategic behavior to resolve doubt,

and in those instances when such a sequence of moves was observed it was assumed that the reader might be using strategic problem solving behavior. The three moves that convey doubt are Monitoring Dooubts (M1), Hypothesis (R1), and Questioning (R3), and results are reported separately for each of these three moves.

Thirty-nine subjects used Monitoring Doubts (M1) on story 1. Fifty-one percent of these subjects used no follow-up move, and on the average, these subjects used move sequences 34% of the time following this monitoring move. The percent of move sequences following monitoring correlated .42 ($p < .01$) with passasge comprehension as measured by the percent of content words retold in the readers' summaries. Thirty-five subjects used monitoring on story 2. Similar to story 1, 43% of these subjects used no follow-up move, and on the average, these subjects used move sequences following 33% of these monitoring moves on story 2. Similar to the first story, the percent of move sequences following monitoring correlated .34 ($p < .05$) with the percent of content words retold.

Thirty-nine subjects used Hypothesis (R1) on story 1. Twenty-eight percent of these subjects used no follow-up move, and on the average, these subjects used move sequences following 46% of these reasoning moves (i.e., R1). The percent of move sequences following hypotheses correlated .20 (NS) with the percent of content words found in readers' summaries. Twenty-eight subjects used hypothesis (R1) on story 2. Similar to the results for story 1, thirty-two percent of these subjects used no follow-up move, and on the average, these subjects used move sequences following 45% of these reasoning moves (R1). The percent of move sequences following hypotheses for story 2 correlated .28 (NS) with the percent of content words retold.

Forty-three subjects used Questioning (R3) on story 1. Thirty-eight percent of these subjects used no move following R3, and on the average, these subjects used move sequences following 45% of these reasoning moves (R3). The percent of move sequences following questioning for story 1 correlated .33 ($p < .05$) with the percent of content words found in readers' summaries. Thirty-three subjects used questioning moves (R3) on story 2. Similar to story 1, 42% of these subjects used no move following R3, and on the average, these subjects used move sequences following 40% of these reasoning moves (R3). The percent of move sequences following questioning for story 2 correlated .25 (NS) with the percent of content words in readers' summaries.

In summary, each of these three measures of move sequences (i.e., sequences following M1, R1, and R3) suggested that this sample used sequential strategies infrequently and this was particularly true for move sequences following monitoring. The close correspondence in these data for stories 1 and 2 suggests that these measures of move sequence are stable across stories. Finally, there were low to moderate correlations between each of these measures of move sequences and comprehension of the passage used to obtain think-aloud protocols. The strongest of these correlations was found for move sequences following monitoring. None of these measures correlated signficantly with the standardized measure of comprehension from the Stanford Achievement Tests.

Discussion

The results of this investigation parallel prior research with "non-problem" elementary school readers indicating that Signaling Understanding, Elaboration and Reasoning are the three most frequently used moves, that Monitoring is used less frequently, and that Analysis and

Judging are used rarely (Meyers, Palladino & Devenpeck, 1987). Since this investigation departed from past research by using a sample of children with reading difficulties, these findings suggest stable patterns of moves used by young readers. Further evidence for the stability of these findings is suggested by the strong correlations between the moves used in the two stories read by each subject. These data and their similarity with earlier research suggest consistency in the behaviors used during reading comprehension by a wide range of elementary school readers.

Another noteworthy finding concerns the correlations between moves and various measures of reading. Consistent with prior research this investigation failed to reveal relationships between the moves assessed by this coding system and a norm-referenced measure of reading comprehension. In contrast, there were consistent significant relationships to comprehension of the think-aloud passage for elaboration, reasoning, and the total number of moves. This is the first investigation indicating such consistent relationships between this coding system and a measure of reading comprehension. One possible explanation is that this measure of comprehension is the most direct test of the impact of moves since both the moves and comprehension are assessed from the same passage. Another possible explanation is that this investigation used a sample of students with difficulty in reading, the use of these categories of moves may be particularly important with this population.

It has been suggested previously that this coding system should be used to examine the sequences of behaviors that occur following doubt (i.e., strategies), and this has been attempted using a case study approach (Lytle, 1985). In contrast, this research investigated the use of move sequences by this entire population by assessing the percent of moves reflecting doubt that were followed by some sequence of other moves.

This approach demonstrated that this sample of problem readers frequently failed to use follow-up moves after acknowledging their doubts, that these measures of move sequences were consistent across the two stories, and that these sequences had low to moderate correlations to passage comprehension.

This investigation makes four unique additions to the literature. It extends earlier research on think-aloud protocol analysis to a population of elementary school students experiencing mild reading problems. It reports data providing information about the sequences of moves used by this population. It uses the number of moves per sentence as a more descriptive criterion measure than those which have been used previously such as frequency or percent of moves used. Finally, it examines the relationship of moves to comprehension when both are assessed with the same passage, and significant correlations were found for Reasoning, Elaboration, the total number of moves per sentence, and certain move sequences.

Future research is needed to replicate the results presented in this investigation. In addition, research is needed to determine how the relative difficulty of reading material, the type of reading material, the purpose of reading, and the instructional context may influence the use of moves and strategies and their relationship to reading comprehension.

References

Afflerbach, P. & Johnston, P. (1984). On the use of verbal reports in reading research. Journal of Reading Behavior, 16, 307-322.

Baker, L. & Brown, A.L. (1984). Metacognitive skills and reading. In P.D. Pearson (Ed.) Handbook of reading reasearch. (pp. 353-395). N.Y.: Longmans.

Balstaedt, S.P. & Mandl, H. (1984). Elaborative Processes. In H. Mandl, N.L. Stein, & T. Trabasso (Eds.) Learning and comprehension of text. (pp. 331-352). Hillsdale, NJ: Lawrence Erlbaum Associates.

Bereiter, C. & Bird, M. (1985). Use of thinking aloud in identification and teaching of reading comprehension strategies. Cognition and Instruction, 2, 131-156.

Brown, A.L. (1980). Metacognitive development and reading. In R.J. Spiro, B. Bruce & W.F. Brewer (Eds.), Theoretical issues in reading comprehension (pp. 453-481). Hillsdale, N.J.: Erlbaum.

Brown, A.L., Armbruster, B. B., & Baker, L. (1986). The role of metacognition in reading and studying. In J. Orasanu (Ed.), Reading comprehension: From research to practice. (pp. 49-75). Hillsdale, NJ: Lawrence Erlbaum.

Ericsson, S.A. & Simon, H.A. (1980). Verbal reports on data. Psychological Review, 87, 215-251.

Flavell, J. (1976). Metacognitive aspects of problem solving. In L.B. Resnick (Ed.), The nature of intelligence. (pp. 231-253). Hillsdale, N.J.: Erlbaum.

Fuchs, L.S., Fuchs, D., & Maxwell, L. (1988). The validity of informal reading comprehension measures. Remedial and Special Education. 9, 20-28.

Gardner, E.F., Rudman, H.C., Karlsen, B., & Merwin, J.C. (1982). Stanford

Achievement Test. San Antonio, TX: Psychological Corporation.

Kintsch, W., & vanDijk, T.A. (1978). Toward a model of text comprehension and production. Psychological Review, 85, 363-394.

Lytle, S. (1982). Exploring comprehension style: A study of twelfth-grade readers' transactions with text. Doctoral dissertation submitted to the University of Pennsylvania.

Lytle, S. (1985). Comprehension styles of twelfth grade readers: What verbal protocols can (and can't) tell us. Paper presented at the annual meeting of the American Ecucational Research Association, Chicago.

Meyers, J. (1988). Diagnosis diagnosed: Twenty years after. Professional School Psychology, 3, 123-134.

Meyers, J. & Kundert, D. (1988). Implementing process assessment. In J. Graden, J. Zins, & M. Curtis (Eds.), Alternative approaches to the delivery of school psychological services. (pp. 173-197). Washington, D.C.: National Association of School Psychologists.

Meyers, J. & Lytle, S. (1986). Assessing the process of learning. Exceptional Children, 53, 138-144.

Meyers, J., Lytle, S., Palladino, D., Devenpeck, G. & Green, M. (unpublished manuscript). Think-aloud protocol analysis: An empirical investigation of reading comprehension strategies in fourth and fifth grade students.

Meyers, J., Palladino, D., & Devenpeck, G. (1987). Think-aloud assessment of reading comprehension: An empirical investigation of fourth and fifth grade students. Paper presented at the Annual Meetings of the National Association of School Psychologists, New Orleans.

Nisbett, R.E. & Wilson, T.D. (1977). Telling more than we can know: Verbal reports on mental processes. Psychological Review, 84, 231-259.

Olshavsky, J. (1976/1977). Reading as problem solving: An investigation

of strategies. Reading Research Quarterly, 12, 654-674.

Orasanu, J. & Penney, M. (1986). Introduction: Comprehension theory and how it grew. In J. Orasanu (Ed.), Reading comprehension: From research to practice. (pp. 1-9). Hillsdale, NJ: Lawrence Erlbaum.

Richardson, E. & DiBenedetto, B. (1985). Decoding Skills Test. Parkton, MD: York Press.

Rumelhart, D. (1980). Schemata: The building blocks of cognition. In R. Spiro (Ed.), Theoretical issues in reading comprehension. (pp.). Hillsdale, N.J.: Erlbaum.

Scardamalia, M. & Bereiter, C. (1984). Development of strategies in text processing. In H. Mandl, N.L. Stein, & T. Trabasso (Eds.), Learning and comprehension of text. (pp. 379 -406).

Table 1

Moves Scored with Scoring System Adapted from Lytle (1982)

Monitoring Moves (M)

- M1 Monitor doubts reflecting awareness of poor understanding, of word or sentence
- M2 Monitor conflicts within text, or between text and reader's knowledge or beliefs

Signaling Understanding (S)

- S1 Reader simply reports understanding of text without paraphrasing
- S2 Paraphrase the sentence's meaning
- S2i Clearly inaccurate paraphrase of the sentence's meaning
- S2t Tentative paraphrase of the sentence
- S3 Summarize the meaning of the text by synthesizing 3 or more sentences

Elaboration Moves (E)

- E1 Use of sensory imagery: visual, auditory, or kinesthetic
- E2 Recall prior knowledge or experience external to text
- E3 Refer to idea stated previously in the text and note connection to current text
- E3i Refer to an idea mentioned previously by reader and note connection to text
- E4 Add details to text without use of imagery
- E5 Personal reaction: interest, like or dislike, or other emotional reaction

Reasoning Moves (R)

- R1 Hypothesis: Forms hypothesis about text; must be tentative
- R2 Prediction about what may happen next
- R3 Ask self question or search for evidence. Can search by re-reading
- R4 Inference or use of evidence to assess hypothesis or prediction, to answer own question, or to resolve doubt
- R5 Revise prior reasoning move

Analysis Moves (A)

- A1 Analyze words
- A2 Analyze sentences including punctuation, grammatical structure, and length
- A3 Analyze functions of paragraph or sentence (e.g., compare, restate, expand, etc.)
- A4 Analyze stylistic aspects: tone, style, type of discourse, etc.

Judging Moves (J)

- J1 Judging ideas, e.g., appropriateness, effectiveness, difficulty, importance, etc.
- J2 Judging text features, e.g., appropriateness, effectiveness, difficulty, etc.

Table 2

Frequency Per Sentence and Range of Moves for Stories 1 and 2

Move	Story 1 Mean Frequency Per Sentence	Story 1 Range	Story 2 Mean Frequency Per Sentence	Story 2 Range
Total Moves/Sentence	**1.38**	**0 - 3.31**	**1.33**	**0 - 4.0**
Monitoring Moves	**.08**	**0 - .62**	**.09**	**0 - .53**
Monitor Doubts (M1)	.08	0 - .62	.08	0 - .53
Monitor Conflicts (M2)	.00	0 - .13	.01	0 - .08
Signal Understanding	**.47**	**0 - .93**	**.42**	**0 - 1.07**
Report Understanding (S1)	.01	0 - .13	.01	0 - .20
Paraphrase (S2)	.37	0 - .80	.31	0 - .93
Inaccurate Paraphrase (S2i)	.09	0 - .44	.10	0 - .77
Summary (S3)	.00	0 - .08	.00	0 - .07
Elaboration Moves	**.40**	**0 - 1.2**	**.41**	**0 - 1.46**
Imagery (E1)	.00	0 - .13	.01	0 - .20
Prior Knowledge (E2)	.02	0 - .20	.02	0 - .20
Prior Text (E3)	.06	0 - .40	.05	0 - .39
Prior Idea (E3i)	.03	0 - .31	.03	0 - .47
Add to Text (E4)	.25	0 - .93	.28	0 - 1.0
Personal Reaction (E5)	.05	0 - .54	.02	0 - .27
Reasoning Moves	**.38**	**0 - 2.67**	**.39**	**0 - 3.08**
Hypothesis (R1)	.15	0 - 2.38	.15	0 - 1.85
Prediction (R2)	.02	0 - .31	.01	0 - .36
Question (R3)	.10	0 - .81	.12	0 - 1.07
Inference (R4)	.11	0 - 1.31	.11	0 - 1.23
Revise (R5)	.00	0 - .08	.01	0 - .33
Analysis Moves	**.02**	**0 - .44**	**.02**	**0 - .27**
Judging Moves	**.02**	**0 - .39**	**.02**	**0 - .67**

Table 3

Correlations Between Standardized Achievement Measures and the Major Categories of Moves

	Decoding Skills	Comprehension	Vocabulary	Language
Total Number Moves				
Story 1	.17	-.21*	-.14	-.04
Story 2	.09	-.22*	-.12	-.03
Monitoring Moves				
Story 1	.29**	-.01	.18	.03
Story 2	.29**	-.02	.23*	.09
Signal Understanding				
Story 1	.30**	.03	-.08	.02
Story 2	.02	.04	-.16	-.18
Elaboration				
Story 1	.02	-.23*	-.14	-.13
Story 2	.04	-.13	-.10	-.01
Reasoning				
Story 1	-.04	-.14	-.13	-.01
Story 2	-.01	-.16	-.06	.04
Analysis				
Story 1	-.01	.05	.08	.16
Story 2	.12	-.07	-.02	.09
Judging				
Story 1	.08	-.14	.18	-.02
Story 2	-.03	-.13	.14	-.01

*** = p< .001
** = p< .01
* = p< .05

Table 4
Correlations of Moves with Comprehension of Think-Aloud Passages
Stories 1 and 2

Move	Story 1	Story 2
Total Moves/Sentence	.54***	.44***
Monitoring Moves	-.09	-.27**
Monitor Doubts (M1)	-.12	-.29**
Monitor Conflicts (M2)	.16	.10
Signal Understanding	.29**	-.16
Report Understanding (S1)	-.13	-.07
Paraphrase (S2)	.22*	-.13
Inaccurate Paraphrase (S2i)	.19*	-.08
Summary (S3)	.11	-.06
Elaboration Moves	.43***	.39***
Imagery (E1)	.34**	.06
Prior Knowledge (E2)	.03	-.01
Prior Text (E3)	.62***	.26**
Prior Idea (E3i)	.22*	.35**
Add to Text (E4)	.31**	.34**
Personal Reaction (E5)	-.17	-.05
Reasoning Moves	.32**	.40***
Hypothesis (R1)	.21*	.25*
Prediction (R2)	.23*	-.11
Question (R3)	-.24*	.02
Inference (R4)	.55***	.67***
Revise (R5)	.03	.06
Analysis Moves	-.05	-.10
Judging Moves	-.06	.02

*** = p< .001
** = p< .01
* = p< .05